KEITHLEY

Model 1755 Calibration Interface Instruction Manual

Contains Operating and Servicing Information

WARRANTY

Keithley Instruments, Inc. warrants this product to be free from defects in material and workmanship for a period of 1 year from date of shipment. During the warranty period, we will, at our option, either repair or replace any product that proves to be defective.

To exercise this warranty, write or call your local Keithley representative, or contact Keithley headquarters in Cleveland, Ohio. You will be given prompt assistance and return instructions. Send the instrument, transportation prepaid, to the indicated service facility. Repairs will be made and the instrument returned, transportation prepaid. Repaired products are warranted for the balance of the original warranty period, or at least 90 days.

LIMITATION OF WARRANTY

This warranty does not apply to defects resulting from unauthorized modification or misuse of any product or part. This warranty also does not apply to contact pins, fuses, batteries, or damage from battery leakage.

This warranty is in lieu of all other warranties, expressed or implied, including any implied warranty of merchantability or fitness for a particular use. Keithley Instruments, Inc. shall not be liable for any indirect, special or consequential damages.

KEITHLEY

KEITHLEY INSTRUMENTS, INC.

INSTRUMENT DIVISION / 28775 Aurora Road / Cleveland, Ohio 44139 / U.S.A. / (216) 248-0400 / Telex: 98-5469
WEST GERMANY: Keithley Instruments GmbH / Heiglhofstr. 5 / 8000 München 70 / (089) 710020 / Telex: 52-12160
GREAT BRITAIN: Keithley Instruments, Ltd. / 1, Boulton Road / Reading, Berkshire RG 2 ONL / (0734) 86-12-87/88 / Telex: 84-7047
FRANCE: Keithley Instruments SARL / 2, Bis Rue Léon Blum / B.P. 60 / 91121 Palaiseau Cedex / (6) 011-51-55 / Telex: 600-933
NETHERLANDS: Keithley Instruments BV / Arkelsedijk 4 / Postbus 559 / 4200 AN Gorinchem / (0) 1830-25577 / Telex: 24-684
SWITZERLAND: Keithley Instruments SA / Kriesbachstr. 4 / 8600 Dübendorf / 01/821-94-44 / Telex: 57-536
AUSTRIA: Keithley Instruments Ges.m.b.H. / Döblinger Haupstr. 32 / 1190 Wien / 314 289 / Telex: 13-4500

Instruction Manual
Model 1755
Calibration Interface

©Keithley Instruments, Inc.
Instrument Division
Cleveland, Ohio, U.S.A.
Document Number 1755-901-01 Rev A

Digitized by the Internet Archive
in 2025

https://archive.org/details/manualsplus_05620

Introduction

The Model 1755 Instruction Manual contains installation and basic programming information for the Model 1755 Calibration Interface. The Model 1755 allows automated calibration and performance verification procedures to be performed over the IEEE-488 bus for appropriate versions of the following instruments in which IEEE-488 interfaces are not installed.

Model 175 Autoranging Digital Multimeter
Model 197 Microvolt Digital Multimeter
Model 485 Autoranging Picoammeter

The Model 1755 Calibration Interface provides both significant cost avoidance and significant cost savings for facilities with numerous Keithley microprocessor-based bench/portable instruments. To automate calibration, a facility need purchase only one IEEE-488 interface option for each type of instrument. Thus, every instrument does not have to be purchased with an IEEE-488 interface. The cost avoidance in additional hardware is substantial.

Furthermore, the Model 1755 permits closed case, automated performance verification and calibration which represents a substantial reduction in labor costs for maintaining a low cost instrument. Thus Model 1755 reduces the total cost of ownership for Keithley instruments.

Required Equipment

The following equipment will be necessary to perform calibration or verification procedures with the Model 1755:

1. Instrument Being Calibrated: The Model 1755 is intended for use with the Models 175, 197, and 485.
2. IEEE-488 Interface Board: The appropriate interface board for the instrument being controlled must be installed within the Model 1755 as follows:

   Model 175 DMM: Model 1753 IEEE Interface
   Model 197 DMM: Model 1973 IEEE Interface
   Model 485 Autoranging Picoammeter: Model 4853 IEEE Interface

   Note that an IEEE interface board designed for one type of instrument cannot be used with another because of software differences.
3. Calibrator: Refer to the appropriate instrument instruction manual for recommended calibration equipment. If substituting equipment, make certain that specifications are at least as good as those given in the manual. For a fully automated system, use an IEEE Interfaceable Calibrator.
4. IEEE-488 Controller: Typical controllers include the Hewlett-Packard Model 85 and the IBM PC computer equipped with the Keithley Model 8573 IEEE-488 Interface.
5. IEEE-488 Cables: Two IEEE-488 cables will be necessary to connect the calibrator and the Model 1755 to the controller. The Models 7007 (with shielded connectors) and 7008 are IEEE-488 cables available from Keithley Instruments, Inc.

6. Calibrator Source Connection Cable: **A suitable cable will be necessary to connect the calibration source to the instrument. Again, refer to the appropriate instrument instruction manual for recommended cables.**

Safety Precautions

When using the Model 1755, observe the following safety precautions:

1. Before operation, ground the Model 1755, instrument, calibrator, and controller through a properly earth-grounded receptacle.
2. Do not exceed the maximum input levels as stated in the specifications for the instrument being tested.
3. Do not exceed the maximum common-mode voltage (voltage between input low and earth ground) as stated in the specifications.
4. Before servicing, disconnect all equipment from the power line and other devices.
5. Do not touch any terminals while the instrument or calibrator are turned on.

Interface Board Installation

Install the appropriate IEEE-488 interface board (Model 1753, 1973, or 4853) in the Model 1755 as follows, using Figure 1 as a guide.

WARNING
Disconnect the Model 1755 line cord from the power line before removing the top cover.

1. Remove the four screws that secure the top cover and remove it. These screws are accessible from the bottom of the interface.
2. Install the rear standoff (supplied with the interface board) by positioning it over the hole in the PC board, as shown in Figure 1. Push down firmly on the standoff until it snaps into place.
3. Position the interface board loosely on the standoff while guiding the pins into the connector (J1008) on the interface board.

WARNING
Do not push down directly on the connector in the next step, as the pins may pass through the connector, possibly causing personal injury.

4. Push down firmly on the interface board near J1008 until the pins are firmly seated.
5. Push down firmly on the interface board near the standoff until the board snaps firmly into place.
6. Make certain that the interface board in seated properly on the shoulders of the two spacers.
7. Replace the top cover and secure it with the four screws removed earlier.

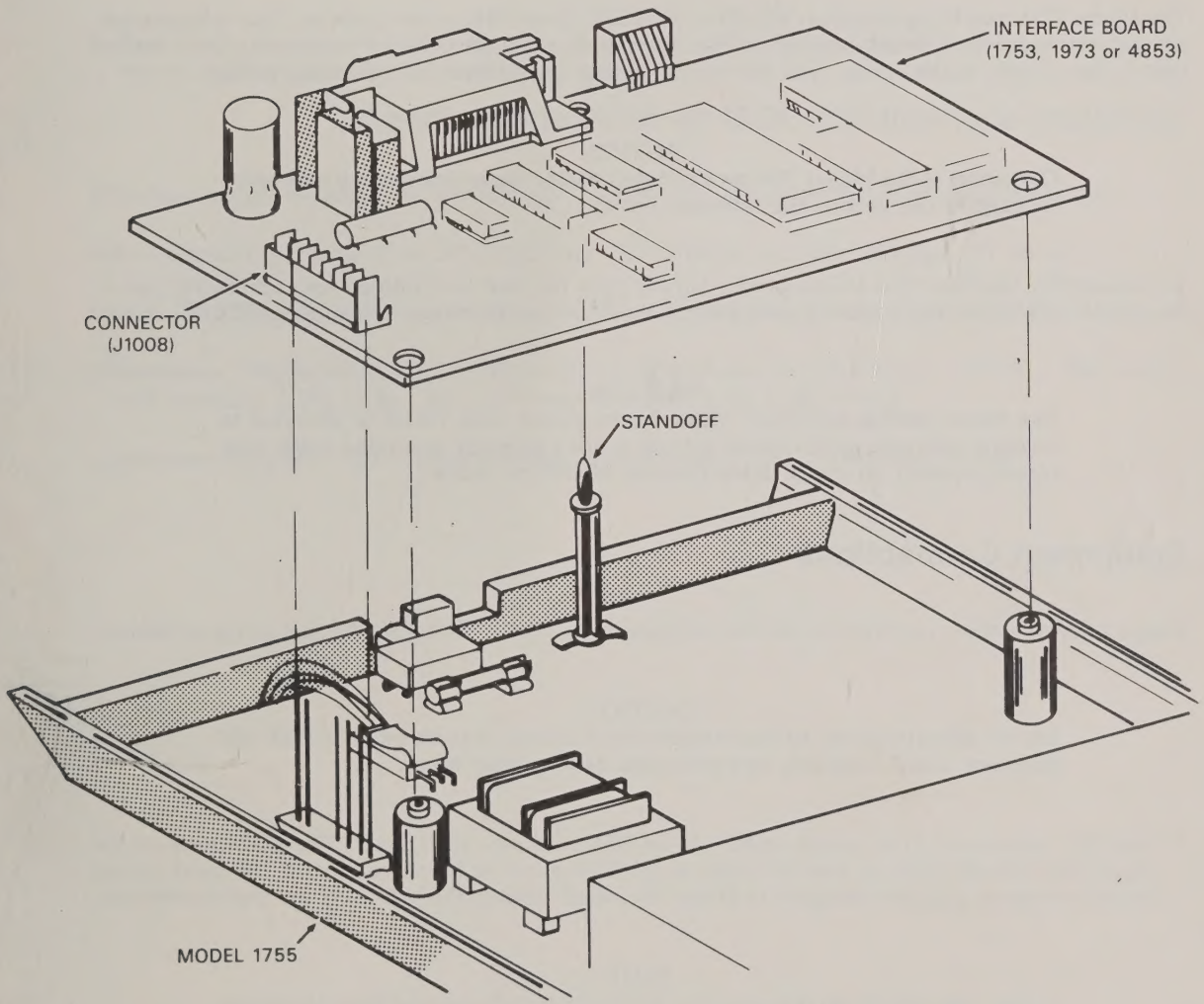


Figure 1. Interface Board Installation

Line Voltage Operation and Selection

The Model 1755 may be operated on 105-125 or 210-250V, 50 or 60Hz power sources. Line voltage selection is performed by a switch located on the rear panel of the unit. Before connecting the interface unit to line power, make certain that the switch setting agrees with the operating voltage.

CAUTION

Operation of the Model 1755 on a voltage outside the selected range may cause damage to the unit or the interface board.

To connect the interface unit to line power, simply plug the line cord into an appropriate AC power receptacle. Since the unit has no power switch, it will be ready for use when plugged in.

WARNING

The Model 1755 is equipped with a 3-wire power cord, which is intended to be used with grounded outlets. Failure to use a properly grounded outlet may cause personal injury or death because of electric shock.

Equipment Connections

Figure 2 shows typical connections for the calibration test setup. Configure the test setup as follows:

CAUTION

Do not attempt to use an instrument which already has an internal IEEE-488 interface board installed, or equipment damage may occur.

1. Place the instrument to be tested on the Model 1755 as shown in Figure 2. The guide pins on the Model 1755 should slide up into the holes in the bottom of the instrument case. The small spring loaded connector pins are designed to fit into the small holes in the bottom of the instrument case.

NOTE

Earlier instruments do not have Rev. B1 or higher software and the appropriate bottom cover assembly. Contact Keithley Instruments for information concerning modification kits for your instrument.

2. Connect both the Model 1755 and the calibrator to the controller using suitable IEEE-488 cables.
3. Connect the calibration source to the instrument input. See the appropriate instrument instruction manual for details.
4. Connect the Model 1755, instrument, calibrator, and the controller to an appropriate AC power source.

NOTE

The instrument being tested must be operated on line rather than battery power, or the interface board will not operate.

5. Turn on the instrument power and allow it to warm up for the prescribed period (see instruction manual) before beginning calibration or verification.

Specifications (with an IEEE-488 Interface Installed)

IEEE-Bus Implementation: See specification of IEEE option for specific instrument under test.

Environment: Operating: 0° to 50°C; less than 80% relative humidity. Storage: -25° to 60°C.

Power: 105-125V or 210-250V (external switch selected), 90-110V available; 50-60Hz, 12VA.

Dimensions, Weight: 89mm high x 235mm wide x 275mm deep (3½ in x 9¼ in. x 10¾ in.). Net weight with interface: 1.5kg (3 lbs., 4oz.). Without interface: 1.4kg (3 lb., 0 oz.)

Accessories Supplied: Spare set of 4 spring loaded contact pins, Instruction Manual.

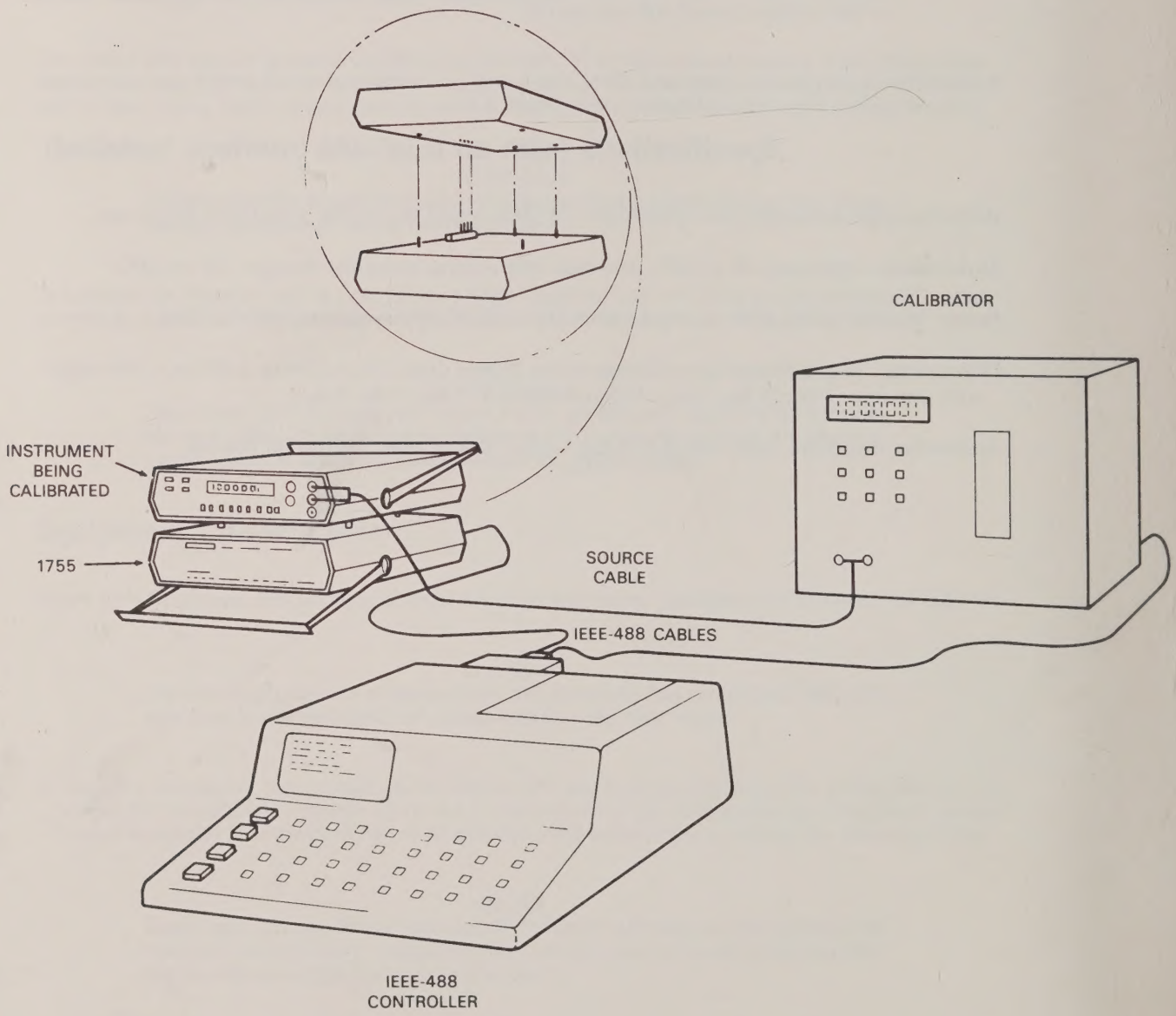


Figure 2. Calibration Test Setup

Calibration Overview

This section contains overview information on primary address selection, calibration procedures, and programming. Refer to the appropriate instrument or interface board instruction manual for more complete information. A summary of device-dependent commands for the Models 175, 197, and 485 is located in the appendix section of this manual.

Primary Address Selection

The primary address of the Model 1755 with the appropriate IEEE-488 interface installed must not conflict with other instruments on the bus, including the calibrator and controller. The Model 1755 primary address is set with DIP switches on the back of the unit (see Figure 3). The primary address may be set to any value between 0 and 30 by setting the switches in the appropriate positions, as summarized in Table 1. Note that the switch positions are read only upon power up.

NOTE

The interface must be in the ADDRESSABLE mode for controlled operation over the bus.

Table 1. Primary Address Switch Positions

Primary Address	MSB 16	8	4	2	LSB 1
0	0	0	0	0	0
1	0	0	0	0	1
2	0	0	0	1	0
3	0	0	0	1	1
4	0	0	1	0	0
5	0	0	1	0	1
6	0	0	1	1	0
7	0	0	1	1	1
8	0	1	0	0	0
9	0	1	0	0	1
10	0	1	0	1	0
11	0	1	0	1	1
12	0	1	1	0	0
13	0	1	1	0	1
14	0	1	1	1	0
15	0	1	1	1	1
16	1	0	0	0	0
17	1	0	0	0	1
18	1	0	0	1	0
19	1	0	0	1	1
20	1	0	1	0	0
21	1	0	1	0	1
22	1	0	1	1	0
23	1	0	1	1	1
24	1	1	0	0	0
25	1	1	0	0	1
26	1	1	0	1	0
27	1	1	0	1	1
28	1	1	1	0	0
29	1	1	1	0	1
30	1	1	1	1	0

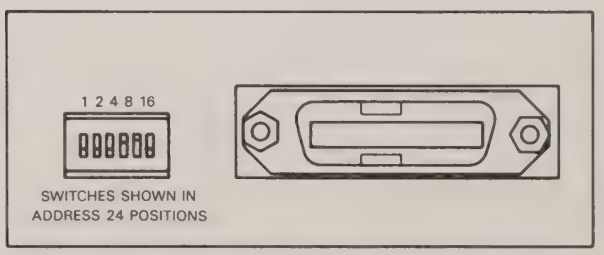


Figure 3. Rear Panel Primary Address Switches

Basic Calibration Procedure

The exact procedure to be used when writing a calibration program will depend on the instrument being calibrated, the calibration source, as well as the controller being used. Figure 4 is a flow chart that shows the general sequence for calibrating a single instrument function-- the DC voltage ranges of a typical instrument.

In general, the procedure is as follows:

1. Place the instrument and calibrator in the remote mode.
2. For the Models 175 and 197, select the function to be calibrated with the appropriate front panel button.
3. Program the instrument for the lowest range. For example, the 175 would be placed on the 200mV range.
4. Program the calibrator output to 0V.
5. Enable the instrument relative mode with the appropriate bus command (Z1X). Leave the relative mode enabled for subsequent ranges on the selected function.
6. Program the calibrator output to the calibration value for the selected range. For example, for the 200mV range, the calibrator output would be set to 190.00mV.
7. Send the calibration command letter followed by the calibration value. For example, if the calibration value is 190.00mV, send the command string V.19X.
8. Select the next higher range and perform steps 6 and 7 for that range. Repeat the procedure for all ranges of the selected function.
9. Where applicable, manually select the next function and repeat the procedure on all ranges.
10. Once all ranges and function have been calibrated, store the new calibration constants in NVRAM by sending the command L0X over the bus. If this last step is not performed, the new calibration values will be lost when power is removed from the instrument, and the unit will revert to former calibration values when it is next turned on.

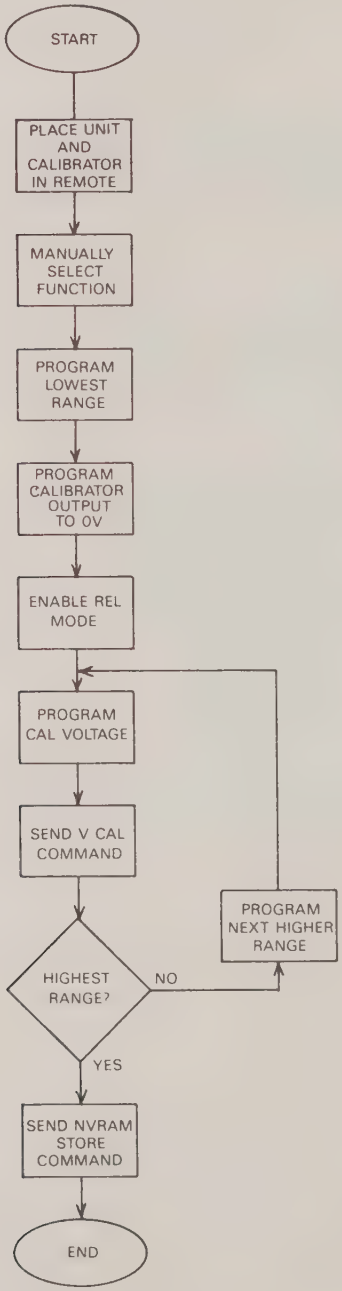


Figure 4. Flow Chart for DCV Calibration

Controller Programs

The two programs below will allow you to send command strings to the instrument using one of two controllers: a Hewlett-Packard Model 85 equipped with the HP-IB interface, and an IBM PC or XT computer equipped with a Keithley Model 8573 IEEE-488 interface. Since calibrator progamming languages vary so widely, programming for that device is not included in these programs. Detailed instrument programming information may be found in the instruction manual for the respective interface board. Device-dependent commands for the Models 175, 197, and 485 are also summarized in the appendix section of this manual.

HP-85 Programming Example—Use the program below to send a command string to the instrument via the Model 1755 and obtain and display a reading string on the computer CRT.

PROGRAM	COMMENTS
`10 CLEAR`	Clear CRT.
`20 DISP ''PRIMARY ADDRESS (0-30)'';`	Prompt for 1755 primary address.
`30 INPUT P`	Input primary address.
`40 IF P < 0 OR P > 30 THEN 20`	Check for primary address limits.
`50 P= P + 700`	Include interface select code.
`60 REMOTE P`	Place unit in remote.
`70 DISP ''COMMAND'';`	Prompt for command.
`80 INPUT A$`	Input command string.
`90 OUTPUT P; A$`	Send command string to instrument.
`100 ENTER P; B$`	Get reading string from instrument.
`110 DISP B$`	Display reading string.
`120 GOTO 70`	Repeat.
`130 END`	

Model 8573 Programming Example—Add the lines below to the DECL.BAS file supplied on the Model 8573 software disk. Note that the declaration file must be modified, as described in the Model 8573 Instruction Manual.

PROGRAM	COMMENTS
`10 CLS`	Clear CRT.
`20 NA$="GPIB0":CALL IBFIND(NA$,BRD0%)`	Assign board descriptor.
`30 NA$="DEV1":CALL IBFIND(NA$,M1755%)`	Assign 1755 descriptor.
`40 INPUT"PRIMARY ADDRESS";P%`	Input 1755 primary address.
`50 IF P% < 0 OR P > 30 THEN 40`	Check primary address limits.
`60 CALL IBPAD(M1755%,P%)`	Set software primary address.
`70 V%=1:CALL IBSRE(BRD0%,V%)`	Send remote enable.
`80 INPUT"COMMAND";CMD$`	Get command string.
`90 IF CMD$="END" THEN 150`	Check to see if program is to end.
`100 CALL IBWRT(M1755%,CMD$)`	Send command string to instrument.
`110 RD$=SPACE$(25)`	Define reading input buffer.
`120 CALL IBRD(M1755%,RD$)`	Get reading string from instrument.
`130 PRINT RD$`	Display reading string.
`140 GOTO 80`	Repeat.
`150 V%=0:CALL IBONL(M1755%,V%)`	Close the instrument file.
`160 CALL IBONL(BRD0%,V%)`	Close the board file.

NOTE

To cleanly exit the program with DOS files properly closed, type in END and press return at the command prompt.

Calibration Program Example

The program below can be used to perform complete calibration of a Keithley Model 175 DMM with revision B1 on later software over the IEEE-488 bus. The following equipment will be necessary to calibrate the instrument using this program:

1. Model 175 DMM being calibrated.
2. Model 1755 Calibration Interface.
3. Model 1753 IEEE-488 Interface (installed within the Model 1755).
4. Hewlett-Packard Model 85 Computer equipped with a HP83937A HP-IB (IEEE-488) interface and an I/O ROM (0085-15003).
5. Fluke Model 5101B Calibrator equipped with a Model 5100A-05 IEEE-488 interface.
6. One Model 7007 or 7008 IEEE-488 cable (one cable is supplied with the HP-IB interface).
7. Connecting cable between calibrator output and instrument input.

Procedure:

1. Connect the equipment together using Figure 2 of this manual as a guide. Place the Model 175 on top of the Model 1755 as previously described. Also make sure that both the Model 1755 and the calibrator are connected to the computer with the IEEE-488 cables, and that the calibrator output is connected to the VOLTS OHMS and COM jacks of the Model 175.
2. Using the rear panel DIP switches, set the primary address of the Model 1755 to 24 (11000_2). Also set the primary address of the calibrator to 17 (10001_2).
3. Connect the instruments to line power and turn them on. Allow a one-hour warm up period before beginning the calibration procedure.
4. Type the program below into the computer; be sure to press the END LINE key after each line is typed. After typing in the program, check it carefully for errors, or the program may not run properly.
5. Press the HP-85 RUN key to initiate the calibration sequence. The program will then send appropriate commands to the instrument and calibrator. At appropriate points, you will be prompted by messages on the computer CRT to manually change functions. When the prompted instructions have been completed, press the HP-85 CONT key to resume the program.

PROGRAM	COMMENTS

```
 10 REMOTE 724,717
 20 CLEAR
 30 DISP " "
 40 DISP "  THIS PROGRAM RUNS A
    FULL CALI-BRATION ON  THE MO
    DEL 175 USING THE FLUKE MODE
    L 5101B"
 50 DISP " "
 60 DISP "  PRESS CONT TO RESUME
     PROGRAM"
 70 PAUSE
 80 CLEAR
 90 DISP " "
100 DISP " SELECT THE DCV FUNCTI
    ON AND    CONNECT THE CALIBR
    ATION SOURCE"                          DC Volts Calibration
110 DISP " "
120 DISP " "
130 DISP " PRESS CONT TO RESUME
    PROGRAM"
140 DISP " "
150 PAUSE
160 OUTPUT 724 ;"R1X"                      Sets 175 to 200mV range.
170 OUTPUT 717 ;"0V,N"                     Outputs 0V to 175.
180 WAIT 1000
190 OUTPUT 724 ;"Z1X"                      Turns REL on.
200 WAIT 1000
210 OUTPUT 717 ;" 19V,N"                   Outputs 190mV to 175.
220 WAIT 5000
230 OUTPUT 724 ;"V.19X"                    Calibrates 200mV range.
240 WAIT 2000
250 OUTPUT 724 ;"R2X"                      Sets 175 to 2V range.
260 OUTPUT 717 ;"0V,N"                     Outputs 0V to 175.
270 WAIT 1000
280 OUTPUT 724 ;"Z1X"                      Turns REL on.
290 WAIT 1000
300 OUTPUT 717 ;"1.9V,N"                   Outputs 1.9V to 175.
310 WAIT 5000
320 OUTPUT 724 ;"V1.9X"                    Calibrates 2V range.
330 WAIT 2000
340 OUTPUT 724 ;"R3X"                      Sets 175 to 20V range.
350 OUTPUT 717 ;"19V,N"                    Outputs 19V to 175.
360 WAIT 5000
370 OUTPUT 724 ;"V19X"                     Calibrates 20V range.
380 WAIT 2000
390 OUTPUT 717 ;"S"                        Sets 5101B to standby.
400 OUTPUT 724 ;"R4X"                      Sets 175 to 200V range.
410 CLEAR
420 BEEP 50,1000
430 DISP " "
440 DISP " WARNING! THE FOLLOWIN
    G STEPS           USE HIGH VO
    LTAGE!"
450 DISP " "
460 DISP " PRESS CONT TO RESUME
    PROGRAM"
470 DISP " "
480 PAUSE
490 DISP " "
500 OUTPUT 717 ;"190V,N"                   Outputs 190V to 175.
```

```
510 WAIT 5000
520 OUTPUT 724 ;"V190X"                    Calibrates 200V range.
530 WAIT 2000
540 OUTPUT 724 ;"R5X"                      Sets 175 to 1000V range.
550 OUTPUT 717 ;"1000V,N"                  Outputs 1000V to 175.
560 WAIT 5000
570 OUTPUT 724 ;"V1000X"                   Calibrates 1000V range.
580 WAIT 2000
590 OUTPUT 717 ;"S"                        Sets 5101B to standby.
600 CLEAR
610 BEEP 50,1000
620 DISP " "
630 DISP "   DC VOLTS CALIBATION
    IS NOW                COMPLE
    TE"
640 DISP " "
650 DISP "      SELECT AC VOLTS
    and..."                                AC Volts Calibration
660 WAIT 2000
670 DISP " "
680 DISP " PRESS CONT TO RESUME
    PROGRAM"
690 PAUSE
700 OUTPUT 724 ;"R1X"                      Sets 175 to 200mV range.
710 OUTPUT 717 ;".19V200H,N"               Outputs 190mV at 200Hz to 175.
720 WAIT 500
730 OUTPUT 724 ;"V.19X"                    Calibrates high end of 200mV range.
740 WAIT 2000
750 OUTPUT 724 ;"D1X"                      Turns dB annunciator on.
760 OUTPUT 717 ;"19E-3V200H,N"             Outputs 19mV at 200MHz to 175.
770 WAIT 5000
780 OUTPUT 724 ;"V19E-3X"                  Calibrates low end of 200mV range.
790 WAIT 2000
800 OUTPUT 724 ;"Z0X"                      Turns dB annunciator off.
810 WAIT 5000
820 OUTPUT 724 ;"R2X"                      Sets 175 to 2V range.
830 OUTPUT 717 ;"1.9V200H,N"               Outputs 1.9V at 200Hz to 175.
840 WAIT 5000
850 OUTPUT 724 ;"V1.9X"                    Calibrates 2V range.
860 WAIT 2060
870 OUTPUT 724 ;"R3X"                      Sets 175 to 20V range.
880 OUTPUT 717 ;"19V200H,N"                Ouptuts 19V at 200Hz to 175.
890 WAIT 5000
900 OUTPUT 724 ;"V19X"                     Calibrates 20V range.
910 WAIT 2000
920 OUTPUT 717 ;"S"                        Sets 5101B to standby.
930 OUTPUT 724 ;"R4X"                      Sets 175 to 200V range.
940 CLEAR
950 BEEP 50,1000
960 DISP " "
970 DISP " WARNING! THE NEXT STE
    PS USE              HIGH VOLTA
    GE!"
980 DISP " "
990 DISP " PRESS CONT TO RESUME
    PROGRAM"
1000 PAUSE
1010 OUTPUT 717 ,"190V200H,N"              Outputs 190V at 200Hz to 175.
1020 WAIT 5000
1030 OUTPUT 724 ;"V190X"                   Calibrates 200V range.
```

```
1040 WAIT 2000
1050 OUTPUT 717 ;"S"                    Sets 5101B to standby.
1060 OUTPUT 724 ;"R5X"                  Sets 175 to 750V range.
1070 OUTPUT 717 ;"750V400H,N"           Outputs 750V at 400Hz to 175.
1080 WAIT 5000
1090 OUTPUT 724 ;"V750X"                Calibrates 750V range.
1100 WAIT 2000
1110 OUTPUT 717 ;"S"                    Sets 5101B to standby.
1120 CLEAR
1130 BEEP 50,1000
1140 DISP " "
1150 DISP "AC VOLTS CALIBRATION
     IS COMPLETE"
1160 WAIT 2000
1170 DISP " "
1180 DISP "SELECT OHMS and REMEM
     BER TO RE-      LEASE THE A
     C BUTTON"                          Ohms Calibration.
1190 WAIT 2000
1200 DISP " "
1210 DISP "  PRESS CONT TO RESUM
     E PROGRAM"
1220 PAUSE
1230 CLEAR
1240 OUTPUT 724 ;"R1X"                  Sets 175 to 200Ω range.
1250 FOR H=0 TO 1                       Sets program for one loop.
1260 GOTO 1270
1270 OUTPUT 717 ;"1Z,N"                 Outputs 1Ω to 175.
1280 WAIT 5000
1290 ENTER 724 ; D                      Enter displayed reading (D).
1300 A=D-1                              A=Test lead resistance and cal error.
1310 OUTPUT 717 ;"100Z,N"               Output 100Ω to 175.
1320 WAIT 5000
1330 B=100                              B=100Ω from 5101B.
1340 F=B+A                              F=Cal point plus lead resistance and cal error.
1350 C$="V"&VAL$(F)&"X"                 C$=Command that calibrates 175 using F.
1360 OUTPUT 724 ;C$                     Calibrate 200Ω range.
1370 WAIT 2000
1380 NEXT H                             Loops to line 1080 once.
1390 OUTPUT 724 ;"R2X"                  Sets 175 to 2kΩ range.
1400 FOR H=0 TO 1                       Sets program for one loop.
1410 GOTO 1420
1420 OUTPUT 717 ;"1Z,N"                 Outputs 1Ω to 175.
1430 WAIT 5000
1440 ENTER 724 ; D                      Enter displayed reading (B).
1450 A=D-1                              A=Test lead resistance and cal error.
1460 OUTPUT 717 ;"1E3Z,N"               Output 1kΩ to 175.
1470 WAIT 5000
1480 B=1000                             B=1000Ω from 5101B.
1490 F=B+A                              F=Cal point plus lead resistance and cal error.
1500 C$="V"&VAL$(F)&"X"                 C$=Command that calibrates 175 using F.
1510 OUTPUT 724 ;C$                     Calibrates 2kΩ range.
1520 WAIT 2000
1530 NEXT H                             Loops to line 1330 once.
1540 OUTPUT 724 ;"R3X"                  Sets 175 to 20kΩ range.
1550 OUTPUT 717 ;"10E3Z,N"              Outputs 10kΩ range.
1560 WAIT 5000
1570 OUTPUT 724 ;"V10E3X"               Calibrates 20kΩ range.
1580 WAIT 2000
1590 OUTPUT 724 ;"R4X"                  Sets 175 to 200kΩ range.
```

```
1600 OUTPUT 717 ;"100E3Z,N"
1610 WAIT 5000
1620 OUTPUT 724 ;"V100E3X"
1630 WAIT 2000
1640 OUTPUT 724 ;"R5X"
1650 OUTPUT 717 ;"1E6Z,N"
1660 WAIT 5000
1670 OUTPUT 724 ;"V1E6X"
1680 WAIT 2000
1690 OUTPUT 717 ;"10E6Z,N"
1700 WAIT 5000
1710 OUTPUT 724 ;"V10E6X"
1720 WAIT 2000
1730 BEEP 50,1000
1740 DISP "   CAL POINTS ARE NOW
     ENTERED"
1750 WAIT 1000
1760 DISP " "
1770 DISP "DO YOU WISH TO STORE
     CAL POINTS           IN NVR
     AM?"
1780 WAIT 1000
1790 DISP " "
1800 DISP "  IF YES,PRESS Y and
     END LINE"
1810 DISP "  IF NO,PRESS N and E
     ND LINE"
1820 INPUT A$
1830 IF A$="Y" THEN 1850
1840 IF A$="N" THEN 1910
1850 OUTPUT 724 ;"L0X"
1860 WAIT 2000
1870 FOR I=1 TO 25
1880 BEEP I*RND+1,50
1890 NEXT I
1900 BEEP 40,3000
1910 DISP "**********************
     ***********"
1920 DISP " THE MODEL 175 CALIBR
     ATION IS             NOW COM
     PLETE."
1930 DISP "**********************
     **********"
1940 END
```

Outputs 100kΩ to 175.

Calibrates 200kΩ range.

Sets 175 to MΩ ranges.
Outputs 1MΩ to 175.

Calibrates 2MΩ range.

Outputs 10MΩ to 175.

Calibrates 20MΩ range.

Stores calibration points in NVRAM.

Program Modifications

The program above can be modified for other instruments and calibrators. A few notes for program modifications are included below.

Primary Address—As written, the program assumes that the primary addresses of the calibrator and Model 1755 are 17 and 24 respectively. If different addresses are used, the primary addresses associated with the REMOTE and OUTPUT statements must be changed accordingly. For example, if you set the primary address of the Model 1755 to 20, the following statement would be used to place the unit in remote: REMOTE 720.

Interface Select Code—The first digit of those statements that include the primary address define the HP-85 interface select code, which is set to 7 at the factory. If you are using a different interface select code for the HP-IB interface, you must modify the associated programming statements accordingly. For example, a typical output statement through an interface with a select code of 5 would be: OUTPUT 524; "R1X".

Sending Commands—Commands that control both the instrument and calibrator are included in a string variable as part of the OUTPUT statement. To send different commands, you need only include the required command string in that OUTPUT statement, as described in the instruction manual for the particular equipment. For example, if a calibrator uses the command "VOLTS19" to program a 19V output, the following programming statement would be used: OUTPUT 726; "VOLTS19". In this instance, we have assumed that the primary address of the calibrator is set to 26.

Modifying Delay Periods—Throughout the example program, the HP-85 WAIT statement is used to incorporate delay periods to allow the equipment to properly respond to commands, and to ensure that calibration signals have properly settled. These delay periods can be changed, as required, by using the correct argument along with the WAIT statement, which gives the delay in milliseconds. For example, to program a 3-second delay, the following statement would be used: WAIT 3000.

Maximizing Programming Efficiency

The example program above uses straight-line programming methods for ease of understanding. In cases where a number of iterations of the same procedure are involved, however, greater programming efficiency can be achieved by using a FOR NEXT loop and placing the instrument and calibrator commands in DATA statements at the end of the program. Another advantage to doing so is that the program can be more easily modified for different programming commands.

The example below demonstrates the loop programming method for the DCV calibration section of the program above (lines 10-590). Another key modification is the assignment of variables for primary addresses. In this way, primary addresses can be later modified without having to go through the entire program.

PROGRAM	COMMENTS
`10 CLEAR`	Clear CRT.
`20 P1=717`	Calibrator primary address is 17.
`30 P2=724`	175 primary address is 24.
`40 REMOTE P1,P2`	Place equipment in remote.
`50 DISP ''SELECT DCV FUNCTION''`	Prompt for operator action.
`60 DISP ''CONNECT CALIBRATOR TO 175''`	
`70 DISP ''PRESS 'CONT' TO RESUME''`	
`80 PAUSE`	Wait to resume.
`90 FOR I = 1 TO 5`	Loop for all five ranges.
`100 OUTPUT P2; ''R'';I;''X''`	Program 175 range.
`110 READ A$,B$`	Read command strings.
`120 OUTPUT P1; A$`	Program calibrator voltage.
`130 WAIT 5000`	Wait five seconds.
`140 OUTPUT P2; B$`	Send cal command to 175.
`150 WAIT 2000`	Wait two seconds.
`160 NEXT I`	Go back and do next range.
`170 OUTPUT P2; ''L0X''`	Store calibration in NVRAM.
`180 DISP ''DCV CALIBRATION COMPLETE''`	
`190 END`	
`200 DATA ''.19V,N'',''V.19X''`	Data statements containing command
`210 DATA ''1.9V,N'',''V1.9X''`	strings for calibrator and 175.
`220 DATA ''19V,N'',''V19X''`	
`230 DATA ''190V,N'',''V190X''`	
`240 DATA ''1000V,N'',''V1000X''`	

Servicing Information

This section contains instructions for top cover and interface board removal, fuse replacement, and a list of replacement parts for the Model 1755 Calibration Interface. Figure 5 shows an exploded view of the unit.

WARNING
The information in this section is intended only for qualified electronics maintenance personnel.

Top Cover Removal

Remove the top cover to gain access to the fuse and other internal parts as follows:

WARNING
Disconnect the Model 1755 from line power before removing the top cover.

1. Place the Model 1755 upside down on a soft cloth.
2. Remove the four screws located in the bottom case.
3. Turn the unit right side up and remove the top cover.
4. To replace the top cover, reverse the above procedure.

Interface Board Removal

Remove the installed IEEE-488 interface board as follows:

1. Squeeze the end of the plastic standoff with a pair of pliers while gently pulling up on the interface board.
2. Place a flat-bladed screwdriver under the interface near the connector and pry up until the board is free of the connector pins.
3. Remove the interface board from the Model 1755 and lay it to one side.

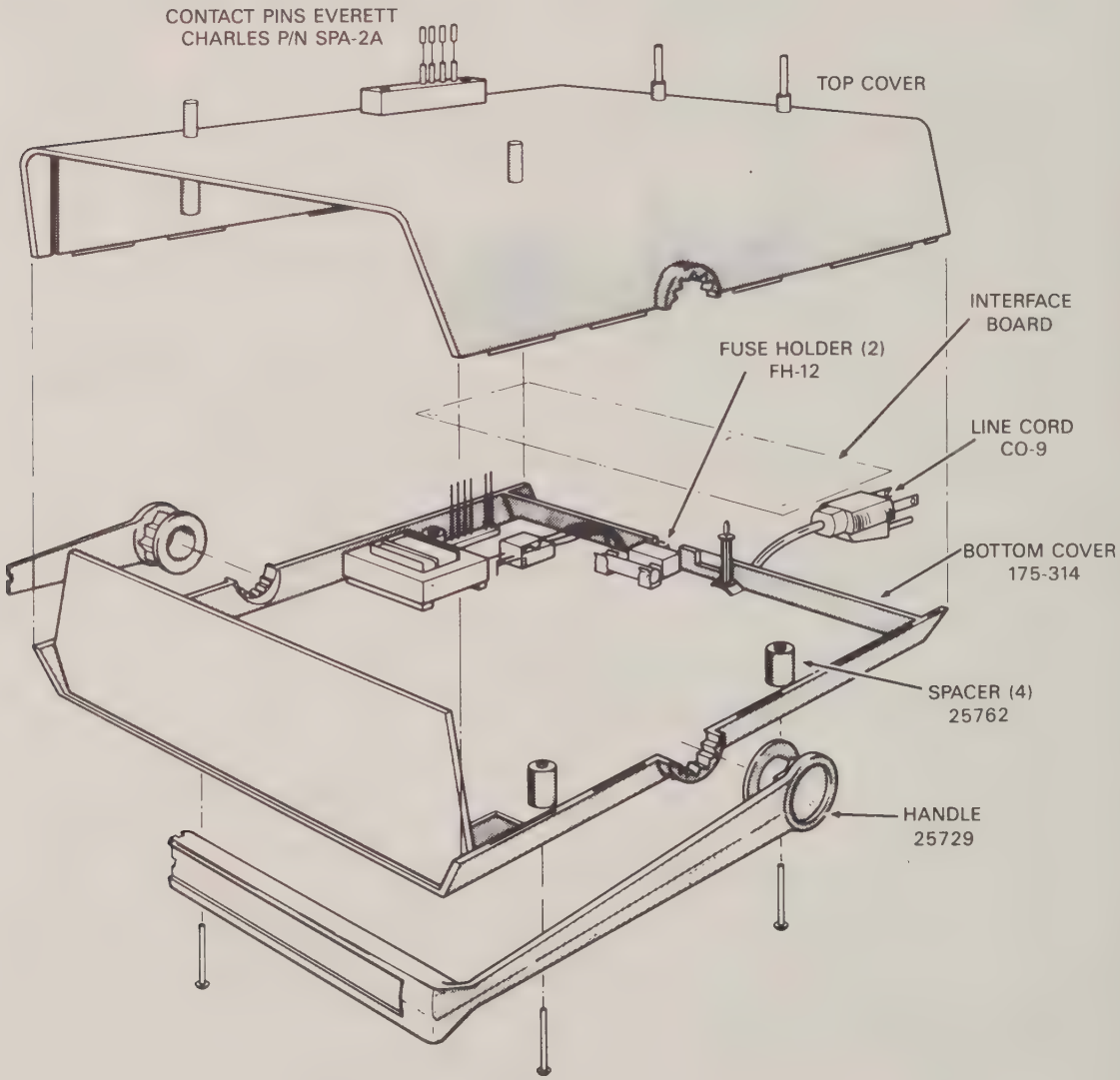


Figure 5. Model 1755 Exploded View

Fuse Checking and Replacement

Check the fuse with an ohmmeter to determine whether it should be replaced. A good fuse will show low resistance, while a bad fuse will be indicated by an infinite reading on a typical ohmmeter.

When replacing the fuse, use only the following type: 1/8A, 250V, Slow Blow, 3AG, Keithley part number FU-20.

Parts Replacement

Table 2 lists Model 1755 replacement parts. Parts for the interface board can be found in the instruction manual for the respective board (Model 1753, 1973, or 4853).

Replacement parts can be obtained from Keithley Instruments, Inc at the address listed inside the front cover of this manual. When ordering parts, be sure to include the model number, part description, and Keithley part number.

Table 2. Model 1755 Parts List

Description	Keithley Part No.
Fuse 1/8 A, 250V, Slow Blow, 3AG	FU-20
Fuse Clip	FH-12
Connector, 3-pin	175-316
Connector, 6-pin	175-321
Switch, Line Voltage Selection	SW-318
Transformer, Power	TR-201
Cord, Line	CO-9
Cover, Bottom	175-314
Handle, Case	25729
Pins, Contact*	

*These contact pins are available from Everett Charles, part number SPA-2A

APPENDIX A
Model 175 Device-Dependent Commands

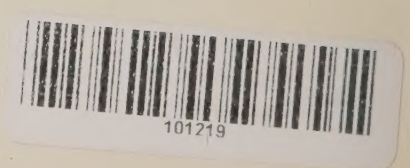
Mode	Command	Description
dB	D0 D1	dB off dB on
Range	 R0 R1 R2 R3 R4 R5	Volts Ohms Auto Auto 200mV 20Ω 2V 2kΩ 20V 20kΩ 200V 200kΩ 1000V MΩ
Relative	Z0 Z1	REL off REL on
Trigger	T0 T1 T2 T3 T4 T5	Continuous on talk. One-shot on talk. Continuous on GET. One-shot on GET. Continuous on X. One-shot on X.
EOI	K0 K1	EOI enabled. EOI disabled.
Status Word	U0	Output status word.
SRQ Mode	Mnn	SRQ on error and/or data conditions.
Data Format	G0 G1	Reading with prefix. Readings without prefix.
Digital Calibration	V±n.nnnnE±nn	n represents calibration value.
Store	L0	Store calibration constants in NVRAM.
Terminator	Y(ASCII) Y(LF) Y(CR) Y(DEL)	ASCII character. CR LF LF CR None
Execute	X	Execute other device-dependent commands.

APPENDIX B
Model 197 Device-Dependent Commands

Mode	Command	Description
dB	D0 D1	dB off dB on
Range	 R0 R1 R2 R3 R4 R5 R6	Volts Ohms Amps Auto Auto — 200mV 200Ω 200μA 2V 2kΩ 2mA 20V 20kΩ 20mA 200V 200kΩ 200mA 1000V MΩ 2000mA — — 10A
Relative	Z0 Z1	REL off REL on
Trigger	T0 T1 T2 T3 T4 T5	Continuous on talk. One-shot on talk. Continuous on GET. One-shot on GET. Continuous on X. One-shot on X.
EOI	K0 K1	EOI enabled. EOI disabled.
Status Word	U0	Output status word.
SRQ Mode	Mnn	SRQ on error and/or data conditions.
Data Format	G0 G1	Reading with prefix. Readings without prefix.
Digital Calibration	V±n.nnnnE±nn	n represents calibration value.
Store	L0	Store calibration constants in NVRAM.
Terminator	Y(ASCII) Y(LF) Y(CR) Y(DEL)	ASCII character. CR LF LF CR None
Execute	X	Execute other device-dependent commands.
Data Logger	B0	Do not send stored readings.

APPENDIX C
Model 485 Device-Dependent Commands

Mode	Command	Description
Zero Check	C0 C1	Zero check off Zero check on
LOG	D0 D1	LOG off LOG on
Range	R0 R1 R2 R3 R4 R5 R6 R7	Auto 2nA 20nA 200nA 2μA 20μA 200μA 2mA
Relative	Z0 Z1	REL off REL on
Trigger	T0 T1 T2 T3 T4 T5	Continuous on talk. One-shot on talk. Continuous on GET. One-shot on GET. Continuous on X. One-shot on X.
EOI	K0 K1	EOI enabled. EOI disabled.
Status Word	U0	Output status word.
SRQ Mode	Mnn	SRQ on error and/or data conditions.
Data Format	G0 G1	Reading with prefix. Readings without prefix.
Digital Calibration	V±n.nnnnE±nn	n represents calibration value.
Store	L0	Store calibration constants in NVRAM.
Terminator	Y(ASCII) Y(LF) Y(CR) Y(DEL)	ASCII character. CR LF LF CR None
Execute	X	Execute other device-dependent commands.



KEITHLEY

KEITHLEY INSTRUMENTS, INC.
INSTRUMENT DIVISION / 28775 Aurora Road / Cleveland, Ohio 44139 / U.S.A. / (216) 248-0400 / Telex: 98-5469
WEST GERMANY: Keithley Instruments GmbH / Heiglhofstr. 5 / 8000 München 70 / (089) 710020 / Telex: 52-12160
GREAT BRITAIN: Keithley Instruments, Ltd. / 1, Boulton Road / Reading, Berkshire RG 2 ONL / (0734) 86-12-87/88 / Telex: 84-7047
FRANCE: Keithley Instruments SARL / 2, Bis Rue Léon Blum / B.P. 60 / 91121 Palaiseau Cedex / (6) 011-51-55 / Telex: 600-933
NETHERLANDS: Keithley Instruments BV / Arkelsedijk 4 / Postbus 559 / 4200 AN Gorinchem / (0) 1830-25577 / Telex: 24-684
SWITZERLAND: Keithley Instruments SA / Kriesbachstr. 4 / 8600 Dübendorf / 01/821-94-44 / Telex: 57-536
AUSTRIA: Keithley Instruments Ges.m.b.H. / Döblinger Haupstr. 32 / 1190 Wien / 314 289 / Telex: 13-4500